

# UNDERSTANDING UI

- ▶ Web application UI is ultimately HTML/CSS/JavaScript
- ▶ Let R users write user interfaces using a simple, familiar-looking API...
- ▶ ...but no limits for advanced users

# Ladder of progression

# LADDER OF UI PROGRESSION

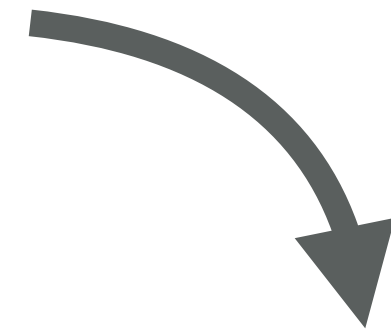
- Step 1. Shiny built-in inputs/outputs and layouts (sidebarLayout, navbarPage, tabsetPanel)
- Step 2. Use functions from external packages (shinythemes, shinydashboard, shinybs)
- Step 3. Use tag objects, write UI functions **Our focus today**
- Step 4. Author HTML templates
- Step 5. Create custom inputs/outputs, wrap existing CSS/JS libraries and frameworks



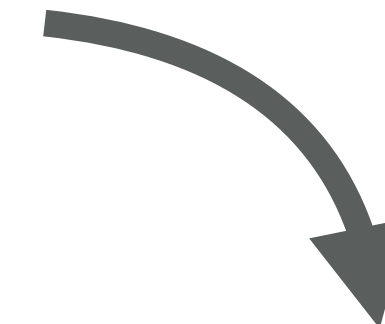
High level  
view

# MULTIPLE LEVELS OF ABSTRACTION

High-level funcs  
`fluidRow(...)`



htmltools tags  
`div(class="row", ...)`



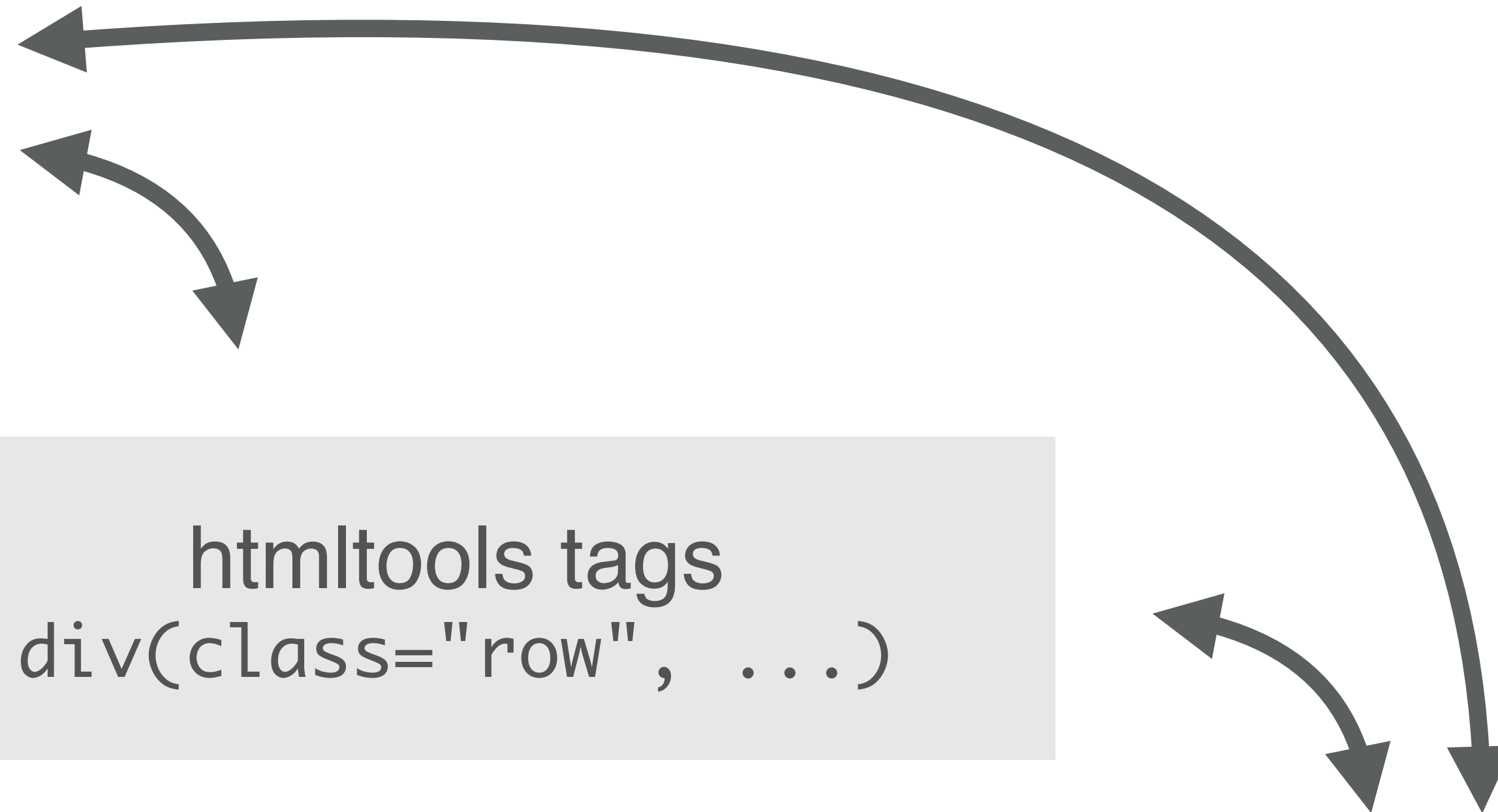
Raw HTML markup  
`<div class="row">...</div>`

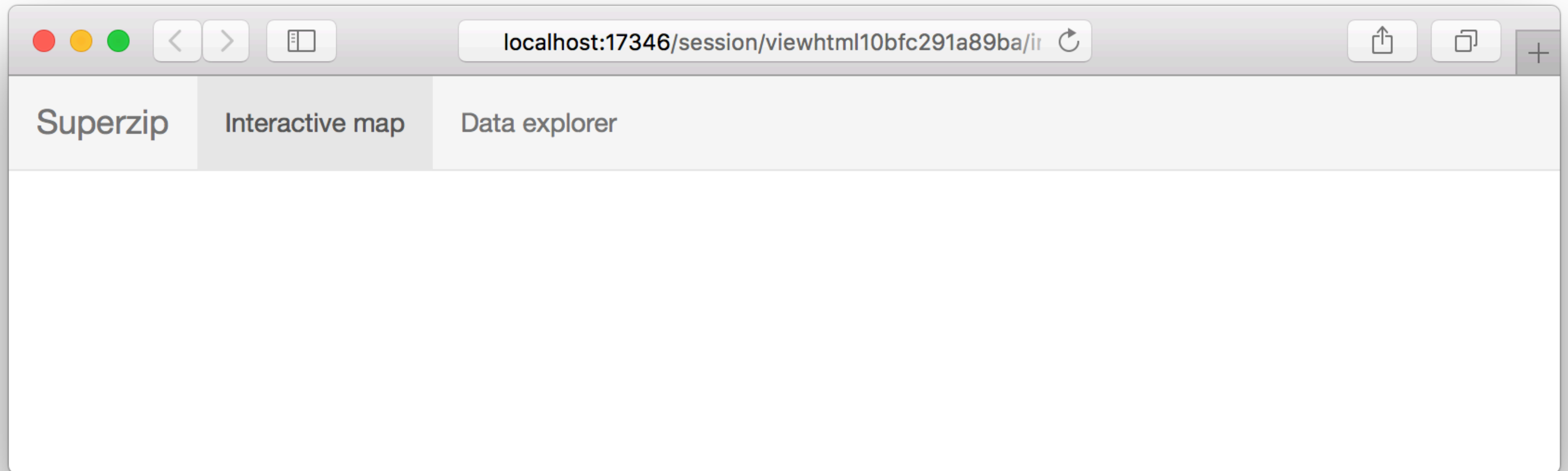
# MIX AND MATCH FREELY

High-level funcs  
`fluidRow(...)`

htmltools tags  
`div(class="row", ...)`

Raw HTML markup  
`<div class="row">...</div>`







# RAW HTML

- Pros
  - Can do anything that's possible in a web page
  - Comfortable for designers, web developers
- Cons
  - Unfamiliar for many R users
  - Potentially lots of HTML needed for conceptually simple tasks
  - CSS/JavaScript dependencies must be handled manually

```
<nav class="navbar navbar-default navbar-static-top" ro
  <div class="container">
    <div class="navbar-header">
      <span class="navbar-brand">Superzip</span>
    </div>
    <ul class="nav navbar-nav shiny-tab-input" id="nav"
      <li class="active">
        <a href="#tab-5158-1" data-toggle="tab" data-va
      </li>
      <li>
        <a href="#tab-5158-2" data-toggle="tab" data-va
      </li>
      <li>
        <a href="#tab-5158-3" data-toggle="tab"></a>
      </li>
    </ul>
  </div>
</nav>
<div class="container-fluid">
  <div class="tab-content">
    <div class="tab-pane active" data-value="Interactiv
      <div class="outer">
        <div id="map" style="width:100%; height:100%; "
        <div class="panel panel-default draggable" id="
```

# HTMLTOOLS OBJECTS

- HTML-generating R functions
- Pros
  - All the power of HTML, but looks like R
  - Automated CSS/JS dependency handling
  - More composable, programmable than HTML
- Cons
  - Easy to misplace commas
  - Almost as verbose as raw HTML

```
nav(class="navbar navbar-default navbar-static-top", rol
  div(class="container",
    div(class="navbar-header",
      span(class="navbar-brand", "Superzip")
    ),
    ul(class="nav navbar-nav shiny-tab-input", id="nav",
      li(class="active",
        a(href="#tab-5158-1", `data-toggle`="tab", `data
      ),
      li(
        a(href="#tab-5158-2", `data-toggle`="tab", `data
      ),
      li(
        a(href="#tab-5158-3", `data-toggle`="tab")
      )
    )
  )
)
```

# HIGH LEVEL FUNCTIONS

- Functions that return htmltools objects
- Pros
  - Less code, clearer intent
  - Anyone can make their own
- Cons
  - Still have to watch out for commas
  - Less flexible

```
navbarPage("Superzip", id = "nav",  
  tabPanel("Interactive map", ...),  
  tabPanel("Data explorer", ...)  
)
```

# Using Shiny built-ins

# SHINY UI BUILT-INS

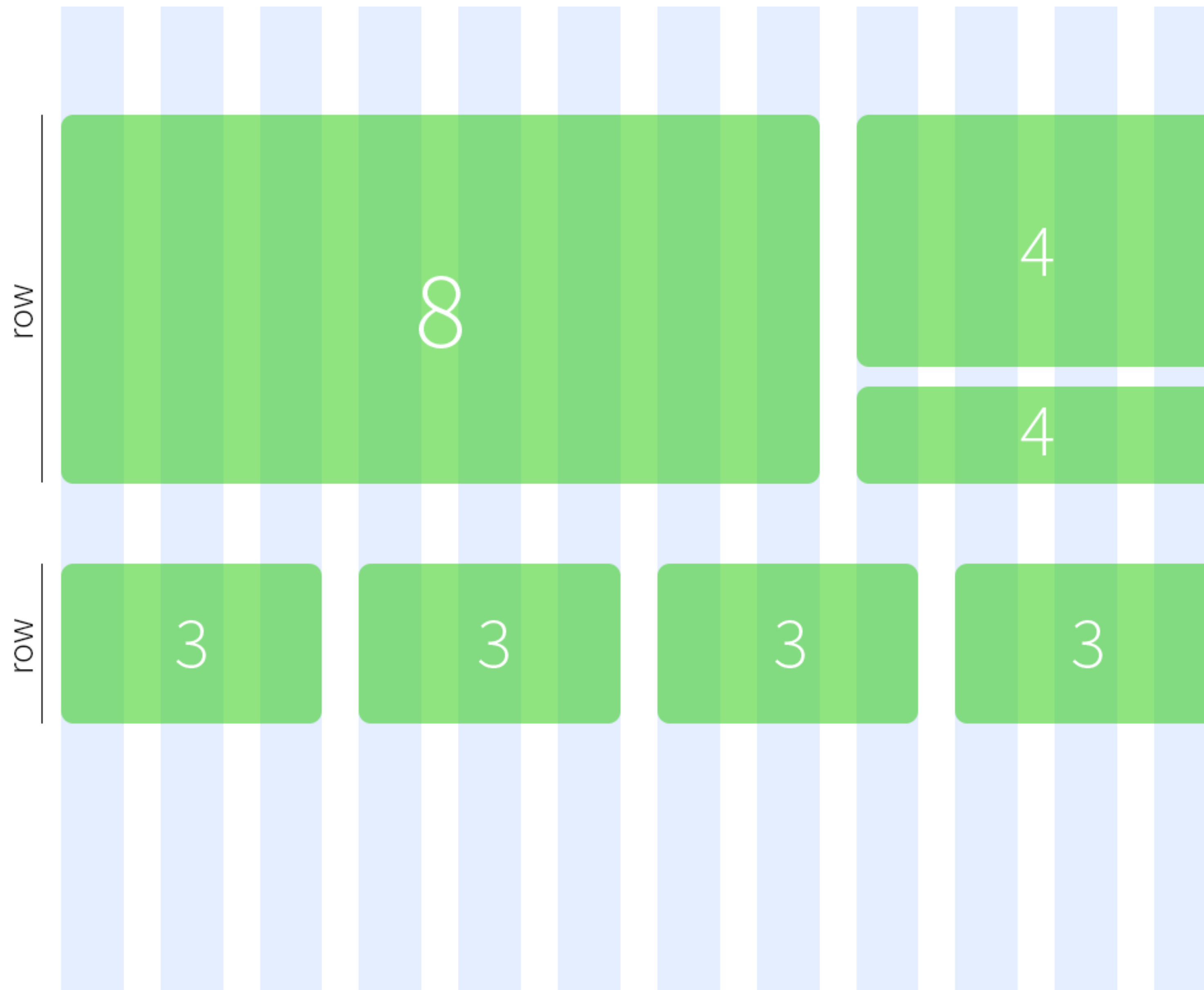
- Bootstrap grid framework – `fluidPage`, `fixedPage`, `fluidRow`, `column`
- Containers – `wellPanel`, `absolutePanel`, `fixedPanel`
- Navigation panels – `tabsetPanel`, `navlistPanel`, `navbarPage`
- Fill layouts (Shiny 0.13+) – `fillPage`, `fillRow`, `fillCol`
- Modals and notifications (Shiny 0.14+) – `showModal`, `modalDialog`



# BOOTSTRAP GRID FRAMEWORK

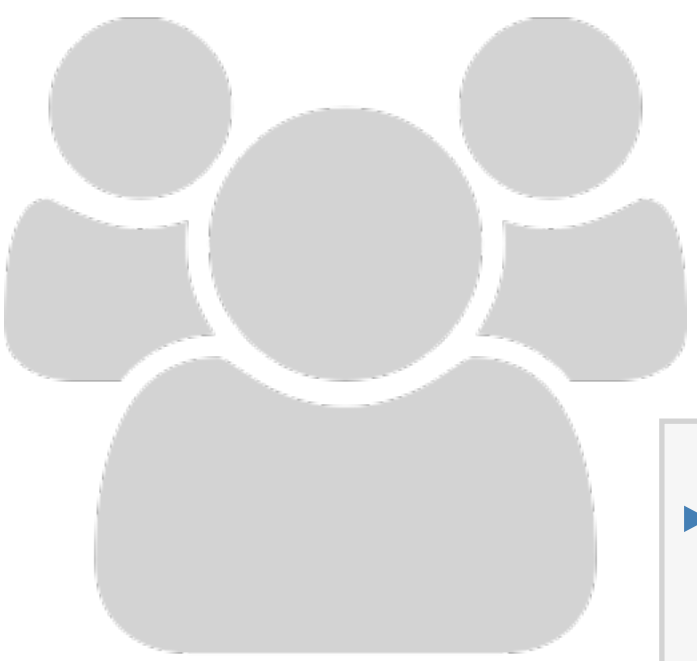
- Every page has 12 invisible columns
- Each column of content must span an integral number of columns
- Simple R API for implementing Bootstrap grid
  - `fluidPage(...)` wraps the entire page
  - `fluidRow(...)` wraps each row's column
  - `column(width, ...)` wraps each column's content





```
ui <- fluidPage(  
  fluidRow(  
    column(8, item1),  
    column(4, item2, item3),  
  ),  
  fluidRow(  
    column(3, item4),  
    column(3, item5),  
    column(3, item6),  
    column(3, item7)  
  )  
)
```

# EXERCISE



- ▶ Modify `ui_01.R` to display the two outputs next to each other (instead of above and below)
- ▶ Assign the left output to be 5 columns wide, and the right output to be 7 columns wide
- ▶ See what happens as you change the width of the browser window

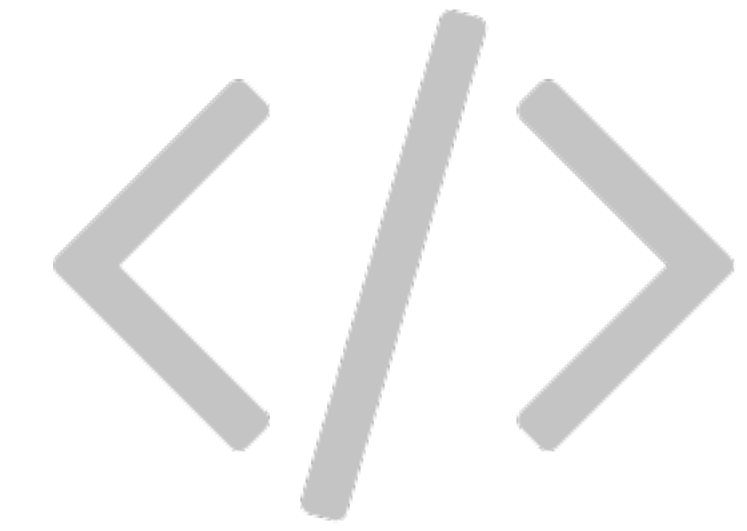
3<sub>m</sub> 00<sub>s</sub>



# SOLUTION

Solution to the previous exercise

`ui_02.R`



# DEMO

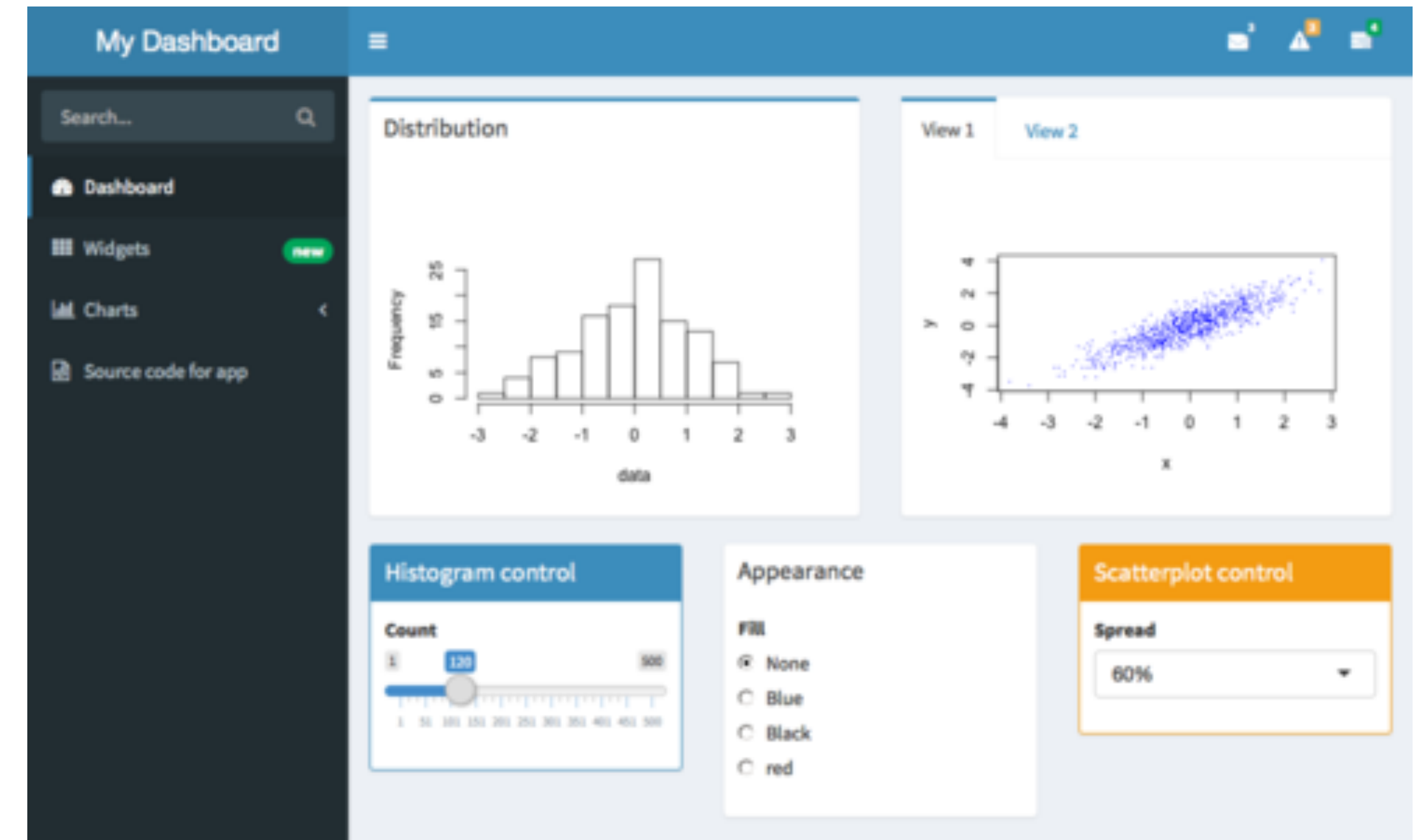
## Layouts

Using external  
packages



# EXTERNAL PACKAGES

- shinydashboard



# EXTERNAL PACKAGES

- ▶ shinydashboard
- ▶ shinythemes

The image displays a collage of Shiny dashboard examples, illustrating the use of external packages like shinydashboard and shinythemes. The dashboards are layered, showing different themes and layouts.

**Themes shown:**

- Darkly:** A dark-themed dashboard with a sidebar on the left containing file input, text input, slider input, and action buttons.
- United:** A dashboard with an orange header bar and a sidebar on the left.
- Flatly:** A dashboard with a dark blue header bar and a sidebar on the left.
- Navbar 1:** A dashboard with a dark blue header bar and a sidebar on the left.
- Plot:** A dashboard with a dark blue header bar and a sidebar on the left.
- Table:** A dashboard with a dark blue header bar and a sidebar on the left.

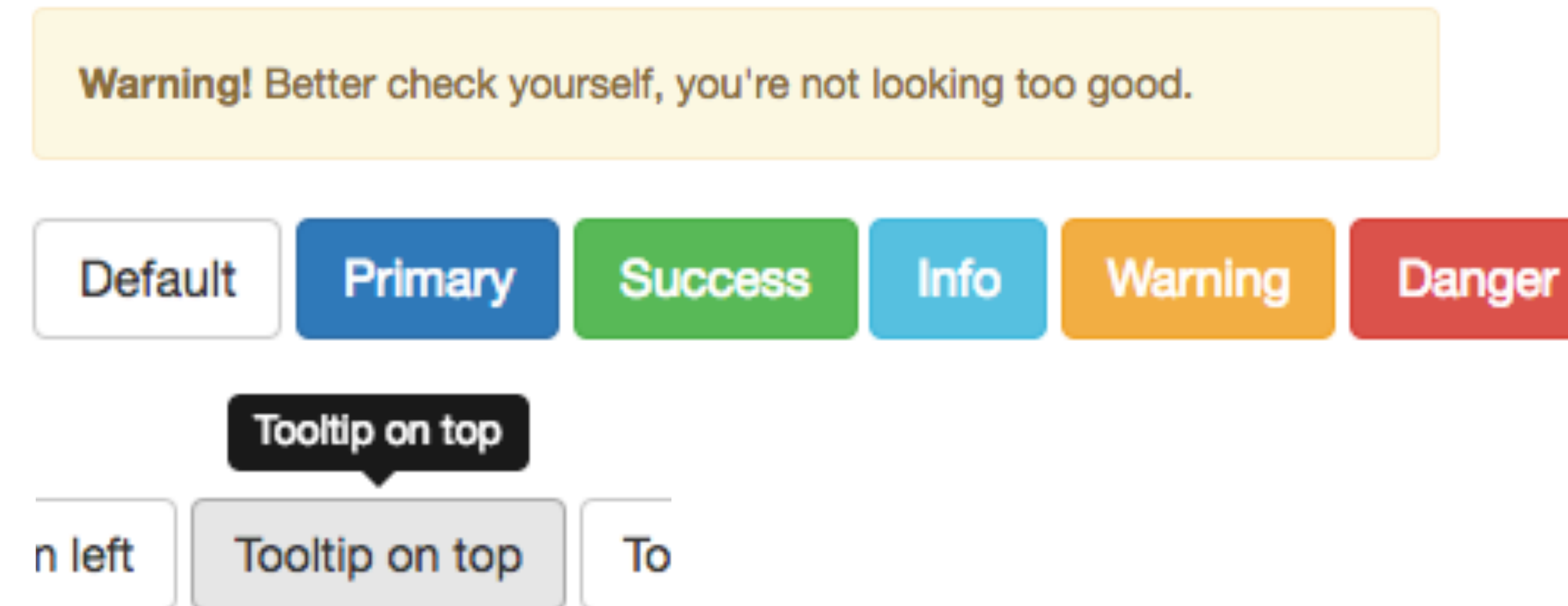
**Dashboard Components:**

- File input:** Includes a "Browse..." button and a "No file selected" message.
- Text input:** A text box containing the word "general".
- Slider input:** A slider with a range from 1 to 100, currently set at 30.
- Default action button:** A button labeled "Search".
- actionButton with CSS class:** A button labeled "Action button".
- Table:** A table with two columns: "speed" and "dist".

speed	dist
4.00	2.00
4.00	10.00
7.00	4.00
7.00	22.00
- Verbatim text output:** A text box displaying the output: "general, 30, NULL".
- Header 1, Header 2, Header 3, Header 4, Header 5:** A series of headers displayed in a list.

# EXTERNAL PACKAGES

- shinydashboard
- shinythemes
- shinyBS (@ebailey78)



# EXTERNAL PACKAGES

- shinydashboard
- shinythemes
- shinyBS (@ebailey78)
- shinytoastr (@gaborcsardi)



Cannot access database



Clock mismatch detected



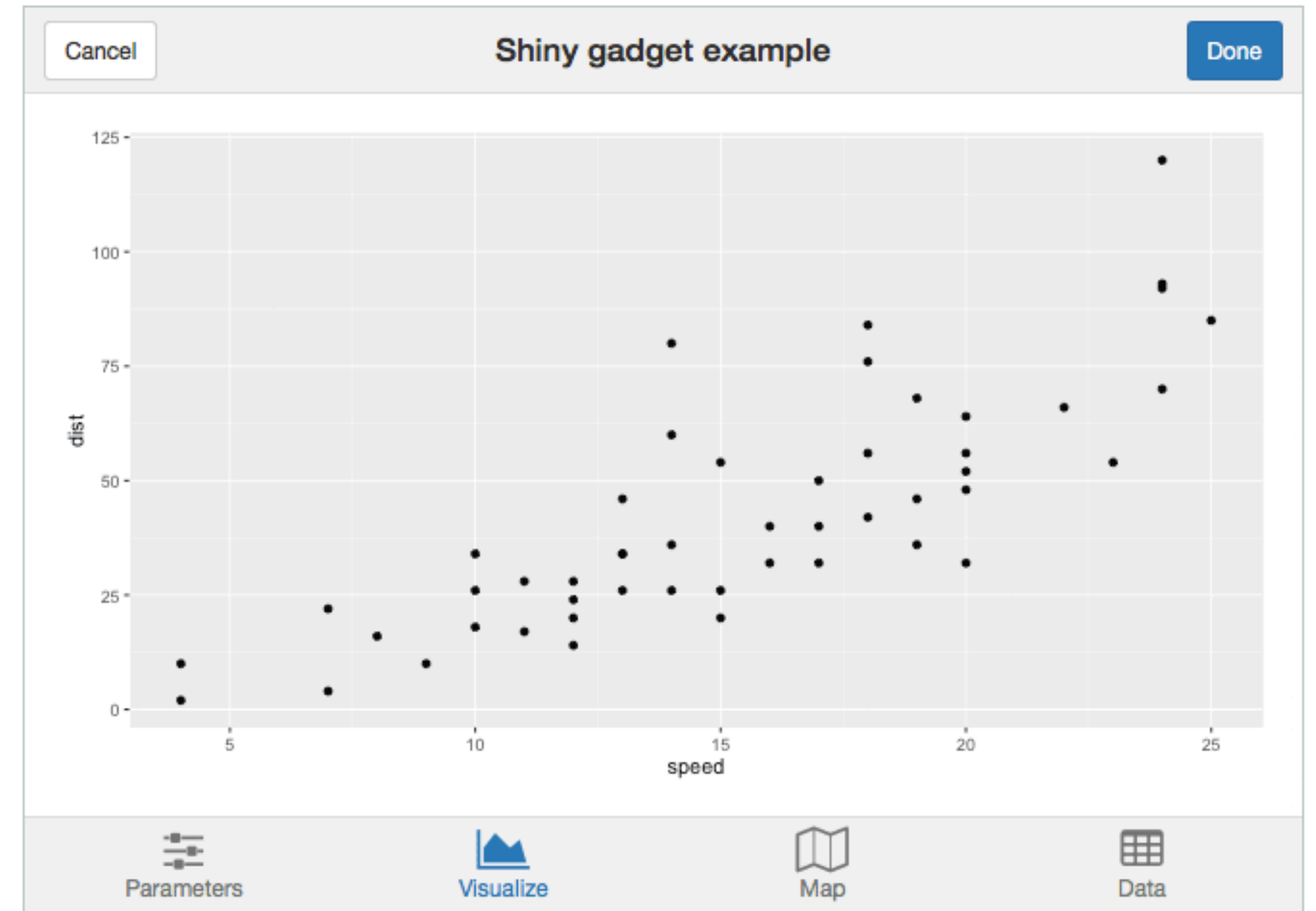
Using the test database



Database updated

# EXTERNAL PACKAGES

- ▶ shinydashboard
- ▶ shinythemes
- ▶ shinyBS (@ebailey78)
- ▶ shinytoastr (@gaborcsardi)
- ▶ miniUI (for mobile devices or Shiny Gadgets)





# EXTERNAL PACKAGES

- shinyjs (@daattali)
- Perform many UI-related JavaScript operations from R

Function	Description
<code>show / hide / toggle</code>	Display or hide an element (optionally with an animation).
<code>hidden</code>	Initialize a Shiny tag as invisible (can be shown later with a call to <code>show</code> ).
<code>enable / disable / toggleState</code>	Enable or disable an input element, such as a button or a text input.
<code>disabled</code>	Initialize a Shiny input as disabled.
<code>reset</code>	Reset a Shiny input widget back to its original value.
<code>delay</code>	Execute R code (including any <code>shinyjs</code> functions) after a specified amount of time.
<code>alert</code>	Show a message to the
<code>html</code>	Change the text/HTML of an element.
<code>onclick</code>	Run R code when a specific element is clicked. Was originally developed with the sole purpose of running a <code>shinyjs</code> function when an element is clicked, though any R code can be used.
<code>onevent</code>	Similar to <code>onclick</code> , but can be used with many other events instead of click (for example, listen for a key press, mouse hover, etc).
<code>addClass / removeClass / toggleClass</code>	add or remove a CSS class from an element.
<code>runjs</code>	Run arbitrary JavaScript code.
<code>extendShinyjs</code>	Allows you to write your own JavaScript functions and use <code>shinyjs</code> to call them as if they were regular R code. More information is available in the section "Calling your own JavaScript functions from R" below.



# EXERCISE



- ▶ Modify `movies_12.R` to use a Bootstrap theme
  - ▶ Use the "Live theme selector" feature in `shinythemes` in your own app
  - ▶ Once you've decided on a theme, remove the theme selector and apply your chosen theme permanently
- ▶ See shinythemes instructions at:  
<https://rstudio.github.io/shinythemes/>

5<sub>m</sub> 00<sub>s</sub>



# SOLUTION

Solution to the previous exercise

`movies_13.R`

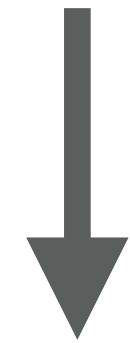
Using `htmltools`  
`tag` objects

# AN API FOR COMPOSING HTML

- ▶ When Shiny was born, it came with a sub-package for composing HTML
- ▶ These functions were so useful, we extracted them out into a separate package: `htmltools`
- ▶ Now used by R Markdown and `htmlwidgets` as well

# HTML BASICS

```
<a href="https://www.rstudio.com">RStudio</a>
```



[RStudio](https://www.rstudio.com)

# HTML BASICS

```
<a href="https://www.rstudio.com">RStudio</a>
```

End tag

Start tag

Child content



Attribute name

# ANATOMY OF A TAG

```
<a href="https://www.rstudio.com">RStudio</a>
```

Tag name

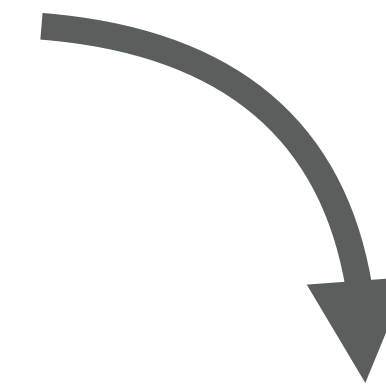
Attribute value

Creates an anchor whose  
hyperlink reference is the URL  
<https://www.rstudio.com>

# ANATOMY OF A TAG

- Text can contain tags
- Tags can optionally contain text and/or other tags
- Each start tag can have zero or more attributes

```
<div class="panel panel-default">  
  <div class="panel-heading">  
    <h3 class="panel-title">Panel title</h3>  
  </div>  
  <div class="panel-body">  
    Panel content  
  </div>  
</div>
```



**Panel title**

Panel content

# LOOKS LIKE R, MEANS HTML

```
<div class="panel panel-default">  
  <div class="panel-heading">  
    <h3 class="panel-title">  
      Panel title  
    </h3>  
  </div>  
  <div class="panel-body">  
    Panel content  
  </div>  
</div>
```

```
div(class="panel panel-default",  
  div(class="panel-heading",  
    h3(class="panel-title",  
      "Panel title",  
    )  
  ),  
  div(class="panel-body",  
    "Panel content"  
  )  
)
```

# USING TAG FUNCTIONS

- ▶ Many common tags are exported as functions by `htmltools` and `shiny` (`p`, `h1-h6`, `a`, `br`, `div`, `span`, `img`)
- ▶ All other tags can be accessed via the `tags` object. E.g., `<li>Item 1</li>` → `tags$li("Item 1")`
- ▶ If you have lots of HTML to write, you can use the `withTags` function—it makes the `tags$` prefix optional.

```
withTags(  
  ul(  
    li("Item 1"), li("Item 2")  
  )  
)
```

# USING TAG FUNCTIONS

- ▶ All tag functions behave the same way
  - ▶ Call the function to create a tag object
  - ▶ Named arguments become attributes
  - ▶ Unnamed arguments become children

# TAG ATTRIBUTES

- Any valid HTML attribute name can be used (use quotes if the name has dashes, e.g. "data-toggle"="dropdown")
- Valid tag attribute values are:
  - NULL (omit the attribute)
  - NA (the attribute should be included with no value)
  - Single-element character vector (or something to be coerced to character)

```
tags$input(type = "checkbox",  
  disabled = if (disabled) NA # else NULL  
)
```



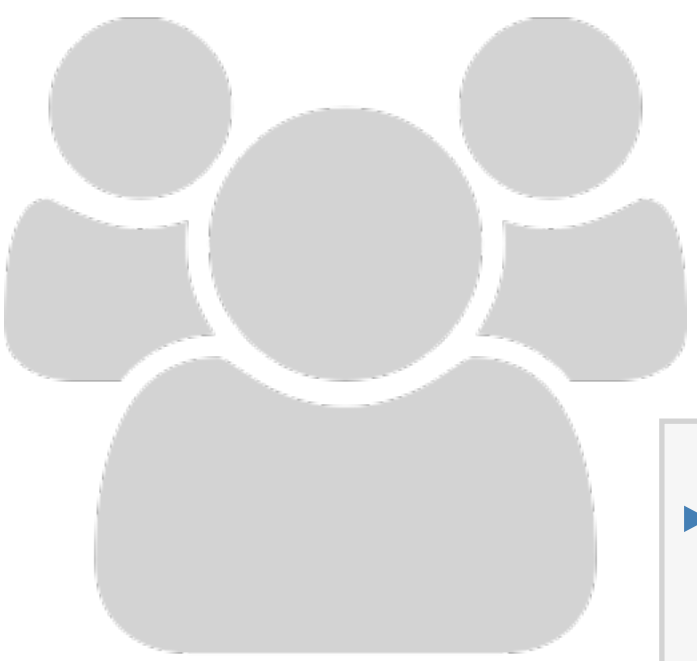
# TAG CHILDREN

- Valid tag children are:
  - Tag objects
  - Single-element character vectors (treated as text)
  - NULL (silently ignored)
  - Raw HTML (see `?htmltools::HTML`)
  - Lists of valid tag children (recursive!)

# USING TAGS

- Tags are made using normal R functions that take normal parameters and return normal values! You can do R-like things to them:  
`tags$ul(lapply(1:10, tags$li))`
- Print tag objects at the console to see their HTML source
  - Call `print(x, browse = TRUE)` to see their rendered view instead
  - Use `htmltools::browsable()` to make an object show its rendered view when printed, by default
  - If your top-level object is a list, you'll need to wrap in `tagList(...)` to get the right behavior at the console (or in an R Markdown doc)

# EXERCISE



- ▶ Open `ui_03.R`.
- ▶ Replace `includeHTML("youtube_thumbnail.html")` with the equivalent `htmltools` tag objects.
  - ▶ Hint: Take a look inside `youtube_thumbnail.html`.
- ▶ If you get that working, take the next step and define an R function that takes a YouTube URL, a title, and a description, and returns a thumbnail frame like the one you created.

5<sub>m</sub> 00<sub>s</sub>



# SOLUTION

Solutions to the previous exercise

`ui_04.R`

`ui_05.R`

Using

raw HTML

# USING RAW HTML

- Incorporate tiny amounts of HTML using inline string literals wrapped in HTML()
  - `div(HTML("This is <strong>HTML</strong>"))`
- For chunks of (static) HTML, use `includeHTML` (or similar `includeCSS`, `includeScript`)
  - `div(includeHTML("file.html"))`
- Or go the other way, with the HTML Templates feature: start with HTML, and embed R expressions that yield tag objects






# UNDERSTANDING UI

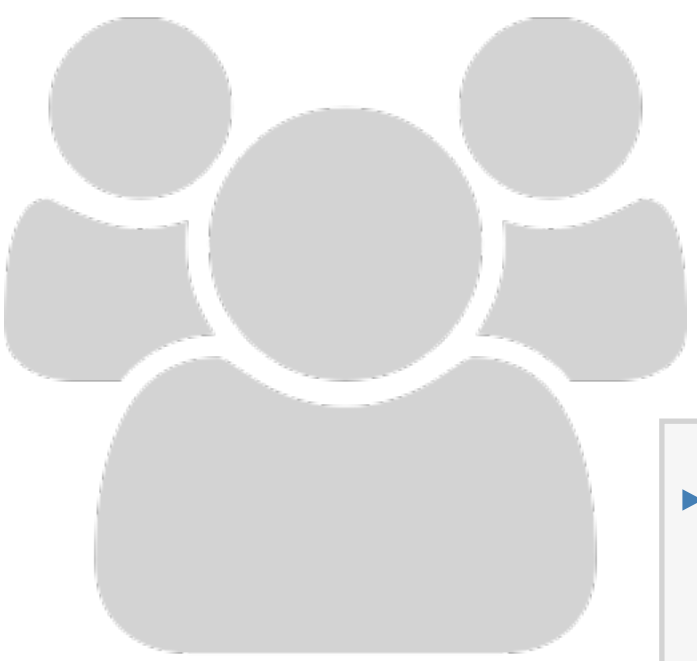


# HINTS FOR HW 1

- Remember that your shiny app needs to be named app.R for it to work on [shinyapps.io](https://shinyapps.io)
- Take choices directly from your dataset
  - ie: `choices = sort(unique(df$foo))` or `choices = names(df)`
- For your outputs, build your table first and make sure your reactive function is working properly first before moving on to plots.
- Build the app on your own from scratch, do not modify one of the in-class examples
  - The amount of time you will spend troubleshooting differences will not save you time in the long run. You also will find the next project much harder.
  - Also, if this practice becomes pervasive, I will be changing the grading expectations for other assignments.

- 
- ▶ Turning in your homework
    - ▶ Upload your app to [shinyapps.io](https://shinyapps.io)
      - ▶ Set the url to the repository in your GitHub repo:
        - ▶ Edit button on the top right near the Settings tab
    - ▶ Email me and Malvika: [gla@andrew.cmu.edu](mailto:gla@andrew.cmu.edu),  
[malvikas.andrew.cmu.edu](mailto:malvikas.andrew.cmu.edu)
      - ▶ Include your GitHub repo link and the [shinyapps.io](https://shinyapps.io) link

# EXERCISE



- Sign up for a [shinyapps.io](https://shinyapps.io) account
  - Go to the Token page under Account
    - Click “Show”
      - Click “Show secret”
        - Click “Copy to clipboard”
- In RStudio go to Global Options
  - Select “Publishing”
    - Click “Connect”
      - Select [shinyapps.io](https://shinyapps.io)
        - Paste your key into the window and click “Create Account”